In-Vacuum Preparation and Characterization of Conductive Polymer Interfaces

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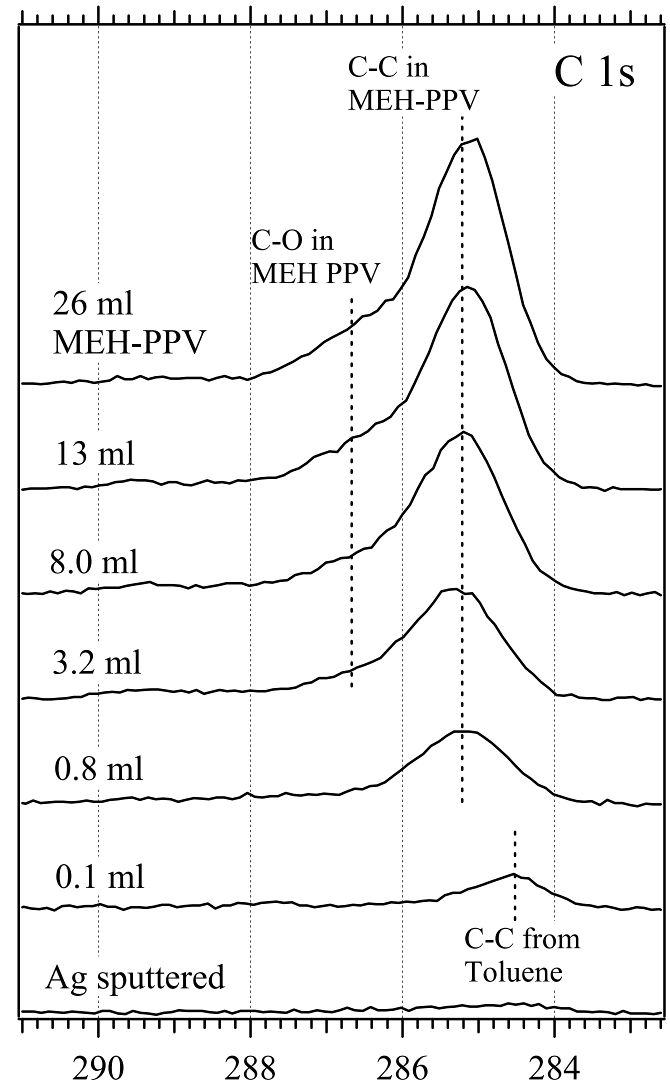
<u>Enabling technique:</u> Electrospray injector for thin film deposition of macro-molecular materials (polymers, bio-materials, supra-molecular materials, nano-crystals) in ultra high vacuum has been developed.

<u>Breakthrough:</u> The electronic structure of macro-molecular thin films and interfaces can now be measured without interference from surface contamination. This enables the detailed characterization of macro-molecular interfaces such as encountered in moletronics devices or plastic electronics. Charge injection barriers, electronic structure of frontier orbitals, chemical interaction can now be determined quickly in one experiment, aiding the tailor design of molecular electronic devices.

<u>Example shown on right:</u> Series of photoemission C 1s core level spectra measured as luminescent polymer MEH-PPV thin film was deposited in multiple steps on a Ag substrate.



Surface scientific methods such as photoemission spectroscopy (PES) have been used to investigate a great number of materials systems in recent decades. Such experiments generally thrive on in-situ sample preparation, since this allows the exclusion of ambient contamination. This effectively prevented many experiments on large-molecular materials such as polymers, bio-materials or nano-crystals in the past. The vast majority of results published in recent years on these materials was obtained by experiments carried out on ex-situ prepared samples. This effectively prevented the detailed measurement of the highest occupied molecular orbital (HOMO) structures due to the inevitable superposition of significant contamination related emissions.

By building an electrospray based deposition system, which allows the direct transfer of molecules from solution to ultra high vacuum (UHV), this challenge has been met. Direct measurement of the electronic structure of macro-moleculeshave become possible. Furthermore, detailed experiments have become possible allowing to directly investigate the formation of interfaces between large molecules and other materials such as electrodes. Aside from such basic research outcomes, this technique will also allow to directly monitor changes of the electronic and chemical structure as moleculaes are modified by adding ligands or strucutral changes. This opens new prospects for the rational design of new technological materials for molecular devices such as sensors or molecular electronics. With respect to industrial applications, the electrospray technique makes large molecule deposition compatible to other vacuum based deposition techniques and also avoids intersolubility issues, which has the potential to enable new production methodologies for the use of macro-molecular materials.